Universitat Internacional de Catalunya
Facultat d'Odontologia
Department de Periodòncia

Tesis doctoral

Three-dimensional volumetric analysis of root coverage and gingival volume gain of multiple recession-type defects treated by Vestibular Incision Subperiosteal Tunnel Access (VISTA).

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Departament of Periodontology
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DOCTORAL THESIS

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Abstract

ABSTRACT

Objective: To examine the outcome of root coverage and gingival volume changes, following the treatment of multiple recession-type defects treated with Vestibular Incision Subperiosteal Tunnel Access (VISTA) in combination with various graft materials.

Materials and Methods: Pre-therapy and post-therapy study models of 21 patients (154 teeth) with multiple gingival recession defects, treated with Vestibular Incision Subperiosteal Tunnel Access (VISTA), were optically scanned. Three-dimensional analysis of superimposed preoperative and postoperative images (more than 12-month follow-up) was performed. Linear and surface root coverage were calculated together with linear gingival thickness and volumetric gain. These outcomes were correlated to various clinical and/or anatomical parameters. A stringent nonparametric regression analysis was run, adjusting for the correlation among multiple observations on the same patient.

Results: The mean percentages of linear root coverage were 96.2 ± 13.1% and 84.3 ± 14.4% for Miller Class I/II (Cairo RT1) and Class III (Cairo RT2) recessions, respectively. The mean percentages of root surface area coverage were 92.1 ± 12.0% and 78.6 ± 15.7% for Miller Class I/II (RT1) and III (RT2) defects, respectively. Linear gingival thickness gain of approximately 1 mm and volumetric gain of 5.47mm3 was achieved. Root prominence, initial recession width and posterior tooth-type were negatively correlated with linear and root surface area coverage. A strong negative correlation was found between linear thickness gain and root prominence. The thickness gained achieved was not significantly different with various graft materials after 14 months post-operatively.

Conclusion: Three-dimensional analysis provides a useful method for evaluating the outcome of periodontal plastic surgery. The results of the present study showed root coverage, gingival thickness and volumetric gain achieved with VISTA in combination with different graft materials. Certain site-specific factors, in particular root prominence, exerted an influence of the outcomes of root coverage and gingival volume gain.

Abbreviations

VISTA: Vestibular Incision Subperiosteal Tunnel Access

I: Incisors

C: Canines

P: Premolars

M: Molars

ADM: Acellular dermal matrix

XCM: Xenogeneic collagen matrix

CTG: Connective tissue graft

KTH: Keratinized tissue height

RD: recession depth

PPD: Probing pocket depth

CAL: Clinical attachment level

RT: Recession type

Tables

Table 1**: Clinical characteristics of included subjects and teeth.**

Patient			
Gender	*Male* (N=8)	*Female* (N=13)	*Total* (N=21)
Mean age (years)	50.5 ± 13.4	53.6 ± 6.5	52.4 ± 9.5
Mean follow up (months)	14.0 ± 3.7	15.0 ± 5.1	14.6 ± 4.6
Mean number of recession/patient	5.6 ± 2.4	8.4 ± 5.9	7.3 ± 5.0
Site			
Anatomic location	*Maxillary* (N=73)	*Mandibular* (N=81)	*Total* (N=154)
Tooth type	*Maxillary* I(N=11) C(N=19) P(N=29) M(N=14)	*Mandibular* I (N=13) C (N=15) P (N=35) M (N=18)	*Total* I (N=24) C (N=34) P (N=64) M (N=32)

Graft type	*Maxillary* Palate (N=16) Tuberosity (N=31) ADM (N=21) XCM (N=3)	*Mandibular* Palate (N=11) Tuberosity (N=32) ADM (N=21) XCM (N=18)	*Total:* Palate (N=27) Tuberosity (N=63) ADM (N=42) XCM (N=21)
RT Class (Cairo)	**I** (N=100)	**II** (N=54)	**Total** (N=154)
Mean initial recession depth (mm)	**RT 1** 2.1 ± 0.8	**RT 2** 2.5 ± 1.0	**Total** 2.2 ± 0.9
Mean initial recession width (mm)	**RT 1** 4.2 ± 1.5	**RT 2** 5.2 ± 2.0	**Total** 4.5 ± 1.7
Mean root prominence (mm)	**RT 1** 0.6 ± 0.5	**RT 2** 1.2 ± 0.6	**Total** 0.8 ± 0.6
Mean initial gingival margin	**RT 1** 1.1 ± 0.2	**RT 2** 0.9 ± 0.2	**Total** 1.0 ± 0.2

thickness (mm)					
Volume gain (mm^3)	**RT 1** 5.15 ± 3.42	**RT 2** 6.05 ± 6.53	**Total** 5.47 ± 4.75		
Thickness gain (mm) at different depths	1 mm depth 1.06 ± 0.30	2 mm depth 1.06 ± 0.36	3 mm depth 0.91 ± 0.30	4 mm depth 0.86 ± 0.30	5 mm depth 0.83 ± 0.33

I:Incisors; **C**: Canines; **P**: Premolars; **M**: Molars; **ADM**: Acellular dermal matrix; **XCM**: Xenogeneic collagen matrix; **CTG**: Connective tissue graft; **RT**: Recession type

Table 2: Clinical measurements taken at pre-operative and post-operative examinations.

	Class I (RT 1)			**Class II (RT 2)**			**Total**		
	Pre-op	*Post-op*	*Change*	*Pre-op*	*Post-op*	*Change*	*Pre-op*	*Post-op*	*Change*
KTH(mm)	2.2±0.9	2.6±0.7	0.4±0.6	1.8±1.0	2.4±0.7	0.5±0.6	2.1±0.9	2.5±0.7	0.4±0.6
RD (mm)	2.1±0.8	0.1±0.3	1.9±0.7	2.5±1.0	0.4±0.4	2.1±1.0	2.2±0.9	0.2±0.3	2.0±0.8
PPD (mm)	2.1±0.4	2.0±0.2	0.1±0.4	2.1±0.4	2.1±0.3	0.1±0.2	2.1±0.3	2.0±0.2	0.1±0.4
CAL (mm)	4.2±0.9	2.1±0.4	2.1±0.8	4.6±1.1	2.5±0.5	2.1±1.0	4.4±1.0	2.2±0.4	2.1±0.9

KTH: Keratinized tissue height; **RD**: recession depth; **PPD**: Probing pocket depth; **CAL**: Clinical attachment level

Figure Legends

Figure 1: Representative clinical cases with multiple gingival recession defects treated with VISTA in combination with allograft or autogenous connective tissue. Preoperative presentation, showing Miller Class I and II (RT1), as well as, Miller Class III (RT2) multiple gingival recession defects (A); initial vestibular vertical incision (B); subperiosteal tunnel elevation beginning at the initial incision (C), apically to the vestibular depth and coronally to the gingival margins; placement of sutures approximately 3 mm apical to the gingival margin of each tooth (D), followed by etching of the teeth; coronal repositioning of the gingival margin and bonding of each suture to the teeth with flowable composite (E); acellular dermal matrix allograft placed inside tunnel (F), and approximation of initial incision with chromic gut suture (G); 12-month follow-up result (H). Preoperative presentation of a case with Miller Class I and II (RT1), as well as, Miller Class III (RT2) multiple gingival recession defects (I); initial vestibular vertical incision (J); elevation of subperiosteal tunnel and placement of sutures bonded to the facial surface of each tooth (K), with subsequent coronal advancement of the gingival margins; autogenous connective tissue graft harvested from the palate (L), that was secured mesio-distally through the vertical incision (M); criss-cross resorbable sutures placed on the palatal donor site (N); final approximation of initial incision with chromic gut suture (O); 12-month follow-up result (P).

Figure 2: Digital analysis illustrating the steps involved in superimposing the study models and creating the 2-dimensional sections used for quantitative measurements. Preoperative (A) and postoperative (B) 3-dimensional models of a patient with multiple gingival recession defects; cropped preoperative (C) and postoperative (D) volumes were imported into the software used for determination of their differences; preoperative and postoperative images were aligned using the semiautomatic N-point alignment tool (E, F); the volume change between preoperative and postoperative images was recorded (G) and a perpendicular cross-section was generated at the level of the midfacial volumetric recession coverage (red area); the 2-dimensional sagittal cut made (H) was used for making quantitative measurements.

Figure 3: **Digital analysis illustrating the steps involved in superimposing the study models and the assessment of gingival volumetric gain**. Pre-operative (A) and post-operative (B) 3-D models of a patient with gingival recession defects in teeth 15, 14 and 13. Common points to both images were used in order to align them (C), until proper superimposition was achieved (D). The color map of both superimposed images (D) shows the augmented volume in red (grafted area), the loss of volume in blue (odontoplasty) and the unchanged surfaces in green. The

dotted dash white lines correspond to the 3D augmented area in the previously denuded root surface. The volume gain between pre- and post-operative images was obtained by subtracting the volumes between the two superimposed images (E). The total volume gain was calculated (7.36 mm^3). The 3-dimensional soft tissue gain of the previously denuded root surface was isolated and positioned over the pre-operative image (F).

Figure 4: Digital quantitation of root prominence (OP:occlusal plane; P-OP: parallel line to occlusal plane; CEJ: cementoenamel junction; DP: distal papilla; MP: mesial papilla; RP: root prominence). A line was drawn at the level of the occlusal plane (OP) in the treatment area (A). The mesial papilla (MP) and distal papilla (DP) were noted. A second line was drawn parallel to the occlusal plane (P-OP) at the level of the most apical of the 2 papillae, which in the case of this site was the MP. The image is then rotated to a sagittal view to better illustrate root prominence (RP) of the canine (B). An axial cut was made at the level of the P-OP (C). In the axial cut, a line was drawn to connect mesial and distal papillae. The distance between the line connecting the 2 papillae and the height of contour of the tooth was measured as "root prominence" (RP).

Figure 5: Outcome of root coverage procedures in gingival recession sites with different Miller Classes. Comparison of the

percentage of linear root coverage and the percentage of root surface area coverage between Miller Class I/II (RT1) versus III (RT2). Asterisk (*) denotes statistical significant difference at $P < .001$ level.

Figure 6: Scatter plot. Illustration of the correlations between root prominence (RP) and the percentage of linear root coverage (blue; $r = -0.80$) and root surface area coverage (orange; $r = -0.83$). Asterisk (*) denotes statistical significant difference at $P < .001$ level.

Figure 7: Linear thickness gain at 1, 2, 3, 4 and 5mm depth from the final gingival margin. The gingival thickness gain at 1mm was higher than at 3mm ($p<0.0001$), 4mm ($p<0.0001$), and 5mm levels ($p<0.0001$); the gain at 2mm was higher than at 3mm ($p<0.0001$), 4mm ($p<0.0001$), and 5mm levels ($p<0.0001$).

Figure 8: Linear thickness gain in maxilla and mandible. Recession defects located in the mandible showed significantly less linear thickness gain at 1mm and 2mm positions than those in the maxilla ($p=0.01$).

Figure 9: Scatter plot illustrating the correlations between root prominence and gingival thickness gain. The correlation between linear

thickness gain and pre-operative root prominence (R2=-0.18) was statistically significant ($p=0.02$).

Figure 10: Gingival thickness gain at 1, 2, 3, 4 and 5mm relative to the post-operative gingival margin, achieved by using various graft materials. No statistically significant differences were found.

Figure 11: Clinical case with multiple gingival recession defects treated with VISTA in combination with autogenous connective tissue graft and porcelain veneers. Multiple Miller Class III (RT2) recession defects with old restorations (A). A vertical incision is performed at the end of the vestibule and a subperiosteal tunnel is created (B). A connective tissue graft is harvested from the posterior palate (C). The graft is then inserted through the vertical incision and stabilized with sutures (D). The sutures are coronally advanced and bonded to the buccal surface of the teeth with fluid composite (E) and the vertical incision is approximated with sutures. 12-month post-operative result, showing root coverage and thickness gain (F).

Figure 12: Clinical situation before and after the periodontal root coverage with VISTA and the restorative treatment with porcelain veneers.

Introduction

Gingival recession

Gingival recession is characterized by the apical migration of the gingival margin from the cementoenamel junction (CEJ), with subsequent exposure of the root surface. The denuded root surface associated with gingival recession can have negative esthetic sequelae on patients, in addition to increased risk of developing dentinal hypersensitivity and root caries. Recession is one of the most common periodontal findings, affecting people with healthy and diseased periodontium, with some studies showing a prevalence as high as 80% of the population (Chambrone et al., 2010).

Various studies have documented the progressive nature of gingival recession. A longitudinal study with 12-year follow-up demonstrated that gingival recession increases with age and sites with existing gingival recession are at the greater risk of progression (Serino et al., 1994). Furthermore, a recent systematic review and meta-analysis of untreated gingival recession defects demonstrated an increased risk of progression during long-term follow-up (Chambrone et al., 2015).

As a result, the surgical correction of these defects via mucogingival surgery appears to be of key importance in the treatment and prevention of future soft tissue complications. Some authors (Zucchelli et al., 2015, Chambrone et al., 2009) have described four main indications for the treatment of these mucogingival defects: esthetic purposes, dentinal hypersensitivity, a deficient band of keratinized tissue and/or deep root abrasion/root caries.

Treatment of gingival recession

Multiple approaches to the treatment of gingival recession defects have been described in the literature (Chambrone et al., 2018), including the coronally advanced flap (CAF) with or without an additional graft, intra-sulcular tunneling (IST), pedicle flaps, free gingival graft (FGG), guided tissue regeneration (GTR), and vestibular incision subperiosteal tunnel access (VISTA). Each of these techniques has its own indications and presents advantages and disadvantages.

Recent systematic reviews have investigated the efficacy of root coverage and reported that the coronally advanced flap (CAF) in combination with a connective tissue graft (CTG) was the gold standard for soft tissue augmentation and periodontal root coverage (Buti et al., 2013, Chambrone et al., 2015). The evidence on the treatment of multiple recession-type defects, particularly Miller Class III (Cairo RT2) and IV (Cairo RT3) defects is scarcer. Few randomized controlled clinical trials have addressed Miller Class III (RT2) (Aroca et al., 2010, Henriques et al., 2010, Cairo et al., 2012

2015). The studies on sites with interproximal attachment loss have demonstrated heterogeneous results with a mean root coverage ranging from 51.5 to 98.0% (Chambrone et al., 2015).

Two systematic reviews have used the available literature to address the outcomes of multiple recession-type defect therapy (Chambrone et al., 2009, Hofmanner et al., 2012). The results showed a mean root coverage ranging from 91.5 to 98.0%, which remains stable in the short-term. For multiple recession-type defects that are Class III (RT2), there is very limited data. Therefore, additional studies that address treatment of multiple recession-type defects, particularly those with interproximal attachment loss, are needed.

VISTA

Vestibular Incision Subperiosteal Tunnel Access (VISTA) may be well suited for the treatment of multiple recession-type defects with presence of interproximal bone loss (Zadeh et al., 2011, Dandu et al., 2018, Gil et al., 2018). This technique consists of a vertical incision made in the vestibule in an area strategically located to provide access to the sites to be treated. A subperiosteal tunnel is elevated through the vestibular access to release and mobilize the mucoperiosteal complex from the vestibular fornix to the gingival margins and extending to the interdental tissues. The mobilized tissues are coronally advanced and anchored with mattress sutures bonded to the buccal aspects of each tooth. No surface incisions are performed on the gingival margin or papillae.

The absence of surface incisions, together with the anchorage provided by the bonded sutures (Zuhr et al., 2018) and the stability of the graft material used, allows for multiple recession-type defects to be treated at once, even when interproximal attachment has been lost.

Predictive factors

The predictive value of various parameters on the outcome of gingival recession therapy has been reviewed (Cortellini et al., 2012). These parameters have been categorized into 3 groups: patient factors, tooth factors and defect/site factors. The most important risk factors presented in the cited study are smoking, presence of interproximal bone loss (gingival recession Class III (RT2), IV (RT3)), thin biotype and deep initial recession (more than 4 mm). Such described factors are related to the outcome of root coverage and not thickness or overall volume gain. There is a need for understanding the influence of these, as well as hitherto unlisted risk factors on the outcome of gingival recession therapy as well as volumetric changes.

Digital volumetric analysis

In order to determine the efficacy of soft tissue augmentation, it is necessary to utilize quantitative methods that can precisely measure post-therapy changes. The most common method used is linear measurements using a periodontal probe, which is limited by the errors associated with utilizing an instrument that measures at millimeter scale and have different angulations and interpretations (Badersten et al., 1984). Such methodological inaccuracies could potentially affect the conclusions reached in clinical studies.

The application of digital volumetric measurements for the quantitation of the outcome of root coverage has many clear advantages and offers unprecedented opportunities. Only a few studies have successfully employed this technology for the analysis of periodontal plastic procedures (Zuhr et al., 2014, Rebele et al., 2014, Schneider et al., 2014, Gonzalez-Martin et al., 2014). Three-dimensional digital analysis allows for the comparison of multiple parameters that cannot be properly measured clinically, such as gingival and root surface contour as well as thickness and volumetric changes.

Gingival volume changes

The importance of gingival thickness has been described with a plethora of studies in numerous periodontal applications (Anderegg et al., 1995, Arora et al., 2013, Puisys et al., 2015). Specifically, flap thickness has been shown to be a predictor for root coverage in mucogingival therapy (Baldi et al., 1999, Hwang et al., 2006). This association with root coverage has been thoroughly investigated (Stefanini et al., 2018), but the assessment of periodontal biotype changes and volume gain after the use of different graft materials is lacking.

Gingival recession represents a denudation of periodontal tissues overlaying the roots (Ozcelik et al., 2015). Since soft tissue loss occurs in three dimensions, it is necessary to study the loss 3-dimensionally. This remains an under-investigated area of periodontal research that demands further attention.

Aim

The aim of this study was to therefore digitally analyze retrospective data to determine the outcome of VISTA, in combination with various graft materials, in the treatment of multiple gingival recession-type defects and assess the association between site-specific characteristics and the therapeutic outcomes. Secondly, volumetric and linear changes in gingival thickness were evaluated after root coverage together with their correlation with such site-specific characteristics.

Hypothesis

Hypothesis

Main hypothesis (first article):

H0 (null hypothesis): there is no correlation between root prominence and linear/surface area root coverage for the treatment of multiple recession defects by Vestibular Incision Subperiosteal Tunnel Access (VISTA).

H1 (alternative hypothesis): root prominence is correlated with linear/surface area root coverage for the treatment of multiple recession defects by Vestibular Incision Subperiosteal Tunnel Access (VISTA).

Secondary hypothesis (second article):

H0 (null hypothesis): there is no correlation between root prominence and gingival thickness and volume gain obtained by Vestibular Incision Subperiosteal Tunnel Access (VISTA) in combination with various graft materials.

H1 (alternative hypothesis): root prominence is correlated with gingival thickness and volume gain obtained by Vestibular Incision Subperiosteal Tunnel Access (VISTA) in combination with various graft materials.

Objectives

Objectives

Primary objective (first article):

- to determine the efficacy of VISTA for linear and surface area root coverage, and to determine the influence of various site-specific characteristics on root coverage.

Secondary objective (second article):

- to evaluate gingival thickness and volume gain after root coverage with VISTA, and to determine the influence of various site-specific characteristics on changes of gingival volume.

To that end, the effect of site-specific properties of teeth (initial root prominence, initial gingival margin thickness, initial recession depth, initial recession width, recession type, tooth type and anatomic location), and the effect of the graft material used were considered on the outcomes evaluated.

Material and Methods

Study design

The protocol of this retrospective study was reviewed and approved by the Institutional Review Board of the University of Southern California. All patients were informed about the details of the participation in the study and signed informed consents accepting being included.

VISTA mucogingival surgery was employed in all patients for the treatment of multiple recession-type defects as part of their routine care. The study population consisted of 21 patients, between 18 to 75 years, contributing 154 teeth with multiple recession-type defects (Table 1).

All of the outcome variables were measured digitally through a reverse engineering software. In addition, clinical parameters were also added (keratinized tissue height, recession depth, probing pocket depth, and clinical attachment level; Table 2) and analyzed together and in 2 subgroups as Miller Class I-II (RT1), and Miller Class III (RT2).

The main outcome variables were linear root coverage and root surface area coverage. The secondary outcome variables were volumetric, as well as linear gingival thickness changes at different locations (1, 2, 3, 4 and 5mm) from the post-operative gingival margin. The clinical and/or anatomical parameters assessed in the study were initial recession depth, initial recession width, initial gingival thickness, types of recession (RT1 vs 2), tooth type (incisor, canine, premolar or molar), graft type (autogenous connective tissue graft from palate or tuberosity, allograft or xenograft), root prominence, and anatomical location in the arch (maxillary vs mandibular).

Characteristics of study participants

The study sample consisted of 21 patients (8 males and 13 females) contributing 154 teeth with multiple gingival recession type defects. Patients had a minimum follow up period of 12 months and a maximum follow up period of 24 months.

All participants met the study inclusion criteria:

- Age between 18 and 75 years
- Multiple Miller Class I-II (RT1), or III (RT2) recession-type defects (>1 mm in depth) on at least 2 adjacent teeth
- Presence of identifiable cementoenamel junction (CEJ) or restorative margin that was in approximate position relative to the CEJ of adjacent teeth and could be used as a reference

- Availability of diagnostic quality study casts at preoperative (within 3 months prior to therapy) and post-therapy (≥12 months postoperatively)

The exclusion criteria for the study were:

- Smoking more than 10 cigarettes a day
- Miller Class IV (RT 3) gingival recession
- Patients taking medication that could affect the gingival health or anatomy
- Previous mucogingival surgeries performed in the area of analysis

Surgical intervention

All patients were treated by VISTA performed by the same periodontist (HHZ), the protocol for which *Figure 1* is briefly described. After administering local anesthesia through infiltration and/or block anesthesia, the exposed root surfaces were treated by scaling and root planning and odontoplasty to reduce excessive root prominence in cervical areas. Ethylene diamine tetra-acetic acid gel (24% pH balanced; PrefGel, Straumann, Basel, Switzerland) was applied for 3 minutes to remove the smear layer and expose collagen fibers.

A vertical vestibular incision of sufficient length was made in a suitable location to allow access to the surgical area. The typical location of this incision in the anterior maxilla was in the midline frenum. For the posterior maxilla, as well as any location in the mandible, the position of the initial incision was between the canine and lateral incisor. A subperiosteal tunnel was elevated, extending from the vestibule to the gingival margin. The tunnel was released sufficiently to advance the gingival margins coronal to the CEJ with minimal tension. A simple interrupted suture or double horizontal mattress sutures (6.0 polypropylene with C3 needle) were positioned approximately 3 mm apical to the gingival margin. The teeth were then etched for 10 seconds. If crown restorations were present, etching was done for 1 minute with porcelain etchant (10% hydrofluoric acid). Each gingival margin was then repositioned at least 2 mm coronal to the CEJ of the tooth and every suture knot was bonded in position to the facial surface of the teeth with flowable composite.

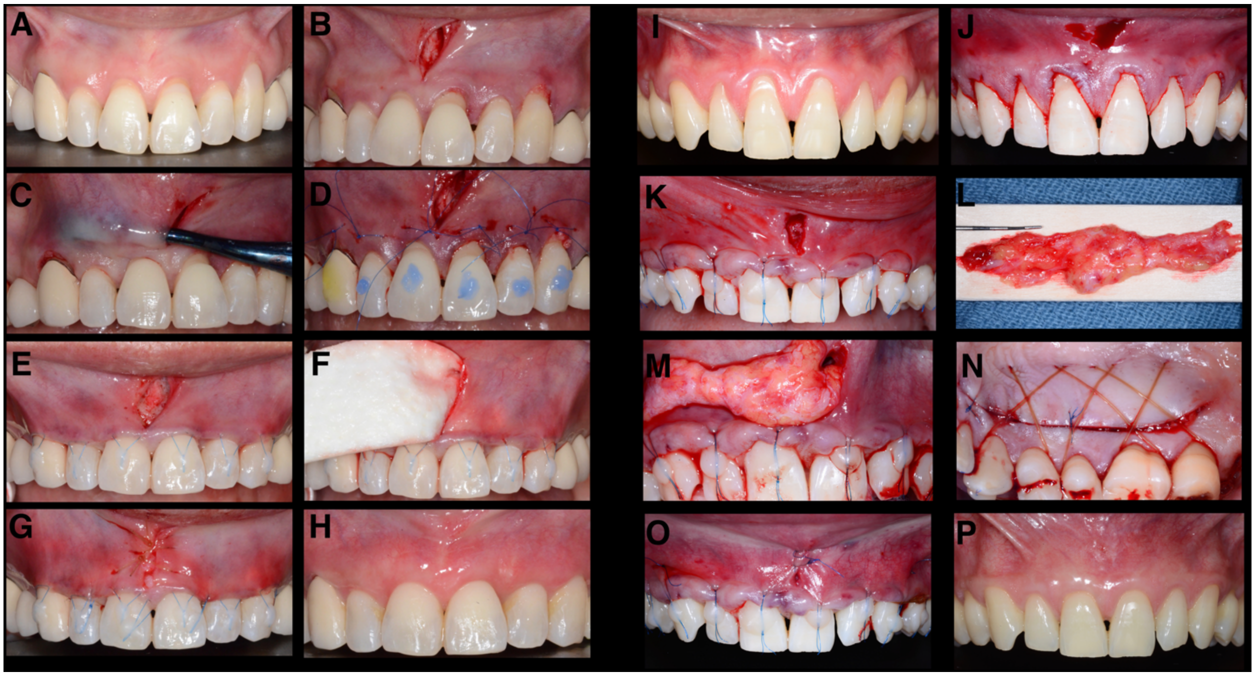

Figure 1

The clinician selected an appropriate graft material, based on clinical considerations, such as the presence and thickness of the preoperative zone of keratinized gingiva, esthetic demand, number of recessions treated, and root prominence. The graft materials used included autogenous connective tissue from palate or tuberosity, acellular dermal matrix allograft (Perioderm; Musculoskeletal Tissue Foundation, Edison, NJ), or xenogenic collagen matrix (XCM, Mucograft; Geistlich Pharma, Wolhusen, Switzerland) in combination with platelet derived growth factor (PDGF; GEM21S, Osteohealth, Shirley, NY).

The graft material was inserted inside the tunnel and stabilized to the overlying mucosa by placement of 6.0 polypropylene interrupted sutures. The initial vertical incision was approximated with 5.0 chromic gut sutures. The sutures were removed 3 weeks post-surgically.

Patients were prescribed antibiotics (amoxicillin or clindamycin), naproxen sodium 550 mg every 12 hours when needed and chlorhexidine rinse 0.12% twice a day for 3 weeks.

Digital volumetric analysis

Alginate impressions were obtained at pre-therapy and post-therapy periods and poured in dental stone. The optical scanning and digital analysis were performed by a single examiner (AG). The study models were scanned with an optical scanner (3-Shape, D850; Copenhagen, Denmark) and saved in Standard Tessellation Language (STL) format. The STL files were imported into a reverse engineering software (Geomagic Control; Cary, NC).

The preoperative and postoperative digitized images were cropped and superimposed by selection of 5 reproducible points on each model. “Global registration” tool was used until both objects were in superimposition. Next, the difference in volume was subtracted using “Boolean” tool and was quantified. To make linear measurements, cross-sections were made at the midfacial point of each tooth being analyzed (*Figure 2*).

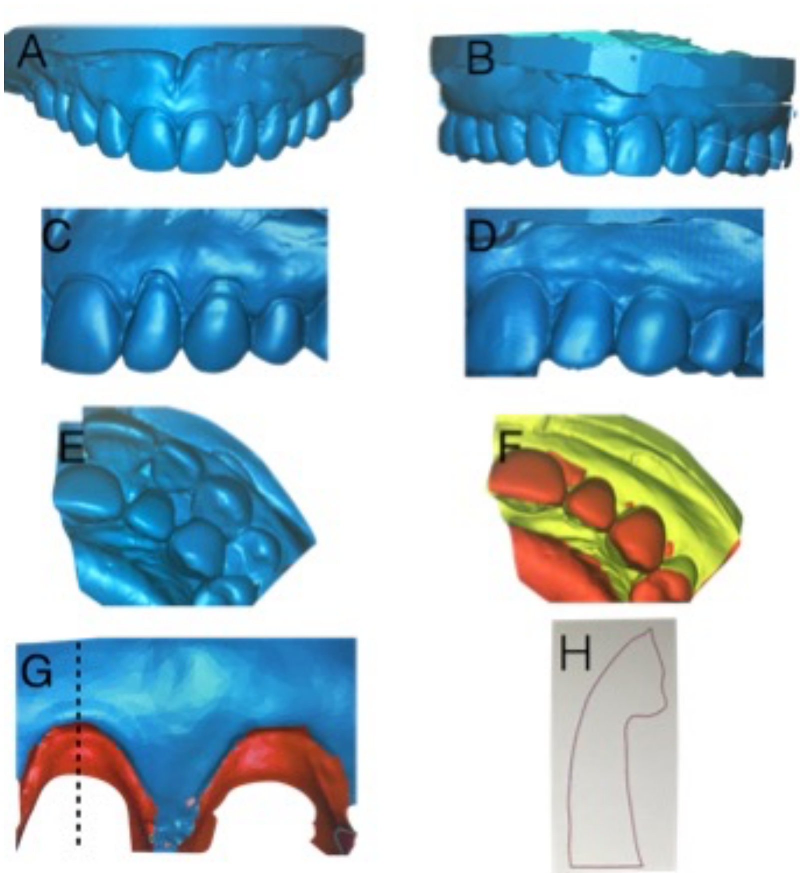

Figure 2

The vertical changes of the midfacial gingival margin from preoperative to postoperative models were recorded and designated as “percentage of linear root coverage.” The difference between the preoperative and postoperative denuded root surfaces divided by the preoperative surface area was used to calculate the "percentage of root surface area coverage" and was recorded in mm2.

Changes in gingival volume were quantified after superimposition of both models. By measuring the change of volume of the tissue overlying the previously denuded root surface, the gingival volume gain was obtained and expressed in mm3 (*Figure 3*).

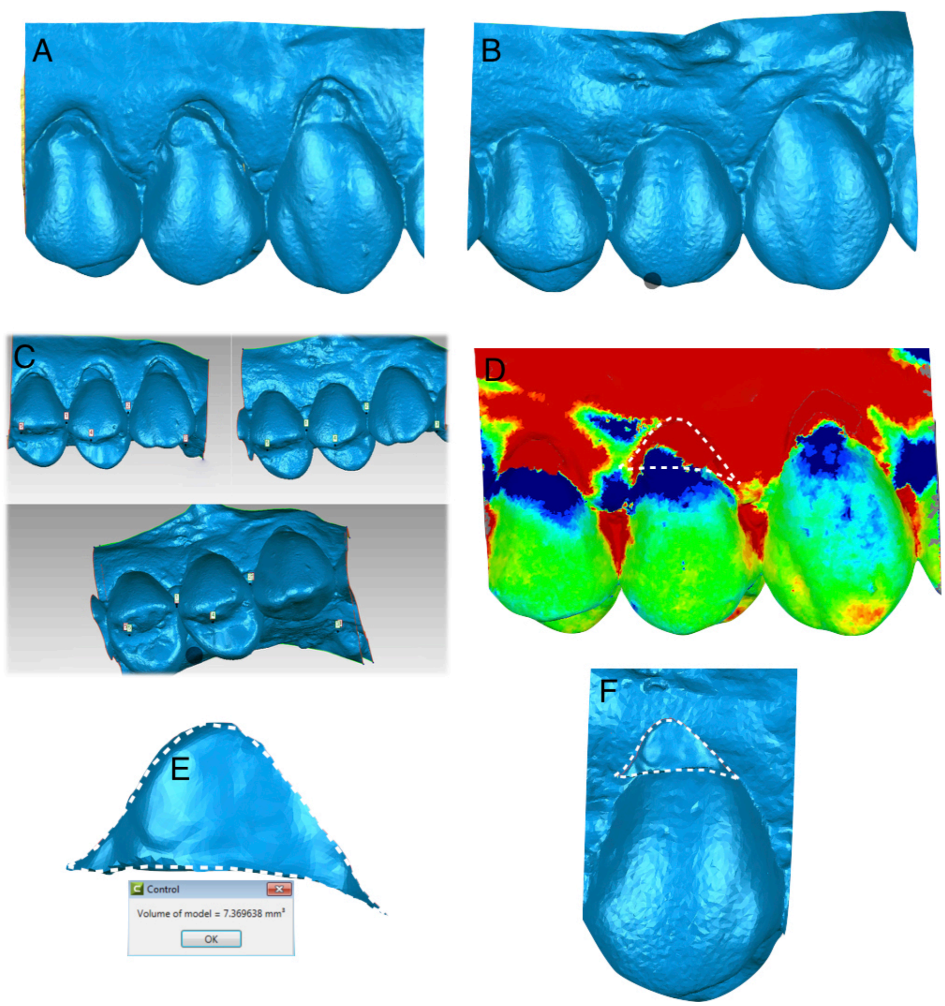

Figure 3

The changes in gingival thickness (mm) were calculated in 2-dimensions in mid-sections of the tooth at 1, 2, 3, 4, and 5mm relative to the post-operative gingival margin.

Root prominence was quantified on the preoperative study models (*Figure 4*). Briefly, 2 parallel lines were drawn: first line at the occlusal plane and a second line parallel to the occlusal plane at the coronal-most point of the more apically positioned papilla tip. In this way, this line was parallel to the occlusal plane and intersected both mesial and distal papillae at their coronal most positions. An axial section was then made for making the measurements. In the axial section, a line was drawn between the points, where the root emerged out of the mesial and distal gingiva. The distance between the midfacial prominence point of the root to this line was calculated and recorded as "root prominence."

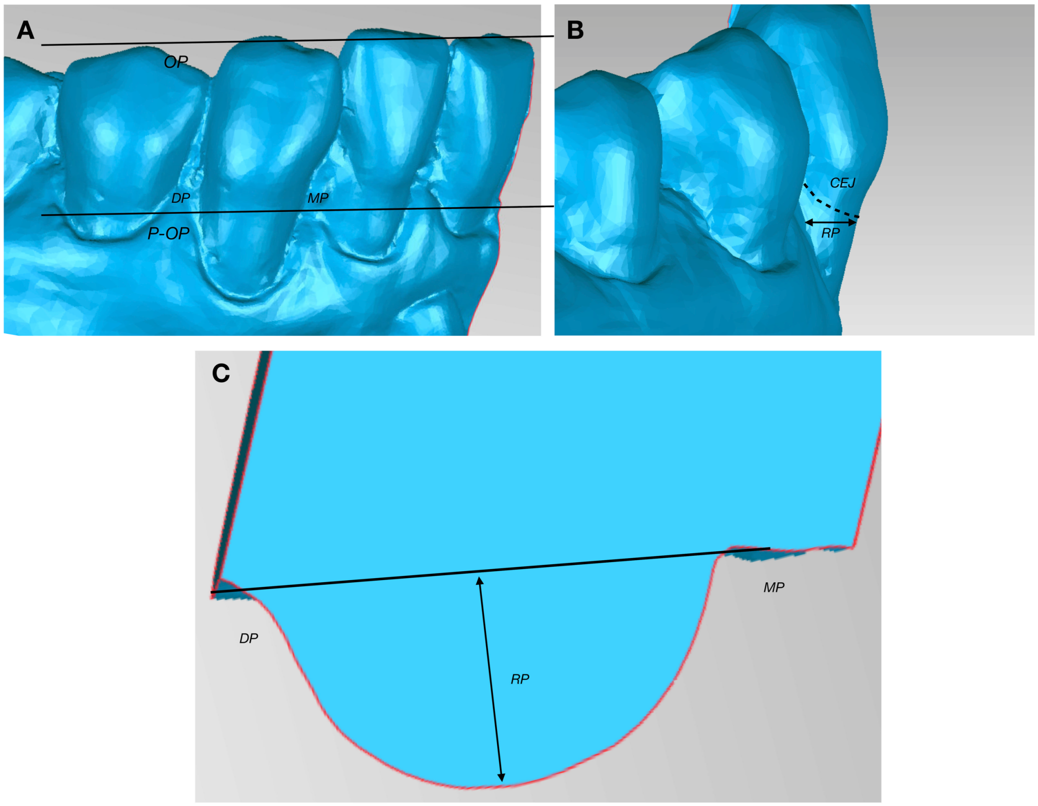

Figure 4

To calculate the initial gingival margin thickness, a sagittal cross section was made at the midfacial position of the tooth, parallel to the interproximal contacts. The bucco-lingual thickness of the gingival margin at this zenith point was measured and designated as "gingival margin thickness."

To calculate initial recession depth and width, the preoperative study model with existing recession was measured vertically and horizontally at the deepest and widest points of the recession. These parameters were recorded as "initial recession depth" and "initial recession width."

Statistical analysis

Descriptive statistics, i.e. mean and standard deviation were calculated for all variables measured. In recognition of the nature of the data, the statistical methodology was utilized to adjust for the relatedness of multiple measures. The nature of this study, by design, was to investigate the outcome of therapy rendered for multiple recession defects.

In an effort to account for these multiple sites within individual patients, a multilevel analysis was conducted. To that end, a stringent nonparametric regression analysis was run, using the methods of Domhof and Langer, adjusting for the correlation among multiple observations on the same patient. All analyses were carried out using SAS version 9.3 (SAS Institute; Cary, NC).

Results

First publication

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Title: Treatment of multiple recession defects with vestibular incision subperiosteal tunnel access (VISTA): A retrospective pilot study utilizing digital analysis

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Results of first publication

Clinical characteristics of patients

The clinical characteristics of the participants, as well as, treated sites are shown in Table 1. The study sample consisted of 21 patients (8 males and 13 females) with a total of 154 multiple recession defects treated (100 Miller Class I/II = RT1 and 54 Miller Class III = RT2 recession defects). A mean of 7.3 ± 5.0 (range 2-24) teeth with recession defects were treated per patient, with a mean follow up of 14.6 ± 4.5 months (range 12-24 months). The mean recession depth and width were 2.2 ± 0.9 mm (range 1.1-6.4 mm) and 4.5 ± 1.7 mm (range 1.8-9.4 mm), respectively. The mean root prominence was 0.8 ± 0.6 mm (range 0-2.5 mm). In addition to the digital measurements, clinical measurements were also taken at preoperative and postoperative examinations (Table 2).

Quantitative analysis (linear and surface area root coverage)

Changes in the midfacial gingival zenith positions were expressed as linear root coverage. The mean percentage of linear root coverage achieved was 96.2 ± 13.1% and 84.3 ± 14.4% for Miller Class I/II (RT1) and Class III

(RT2) recessions, respectively (*Figure 5*). The percentage of linear root coverage achieved was significantly higher for Miller Class I/II (RT1), compared with Miller Class III (RT2) recession defects (P < 0.001). Complete linear root coverage was achieved among 70.0% of Miller Class I/II (RT1) recession defects, and 22.2% for Miller Class III (RT2) defects, a difference which was statistically significant (P < 0.001).

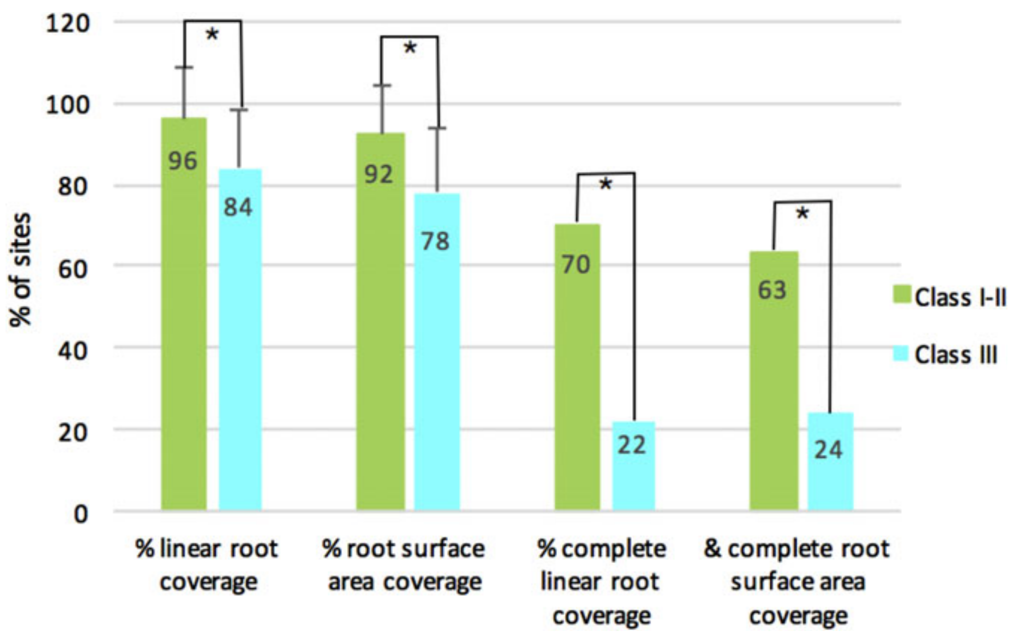

Figure 5

The surface area of denuded roots in the preoperative scanned casts was calculated. The percentage of root surface area coverage was 92.1 ± 12.0% for Miller Class I/II (RT1) recession defects, and 78.6 ± 15.7% for Miller Class III (RT2) (*Figure 5*). These two means were significantly different (P < 0.001).

Complete root surface area coverage was achieved among 63.0% of Miller Class I/II (RT1) recession defects, and 24.0% for Miller Class III (RT2) defects, a difference which was statistically significant ($P < 0.001$).

Incisors had higher percentage of linear root coverage than either molars ($P < 0.001$) or premolars ($P = 0.03$). Canines had higher percentage of linear root coverage than molars ($P < 0.001$), but not premolars ($P = 0.08$). Premolars had higher percentage of linear root coverage than molars ($P < 0.001$). Incisors, canines and premolars showed a higher percentage of root surface area coverage than molars ($P < 0.001$).

The mean root prominence showed a highly statistically significant negative correlation with linear root coverage ($r = -0.80$; $P < 0.001$) and root surface area coverage ($r = -0.83$; $P < 0.001$; *Figure 6*). A precipitous drop in root coverage was observed in sites with root prominence greater than 1 mm.

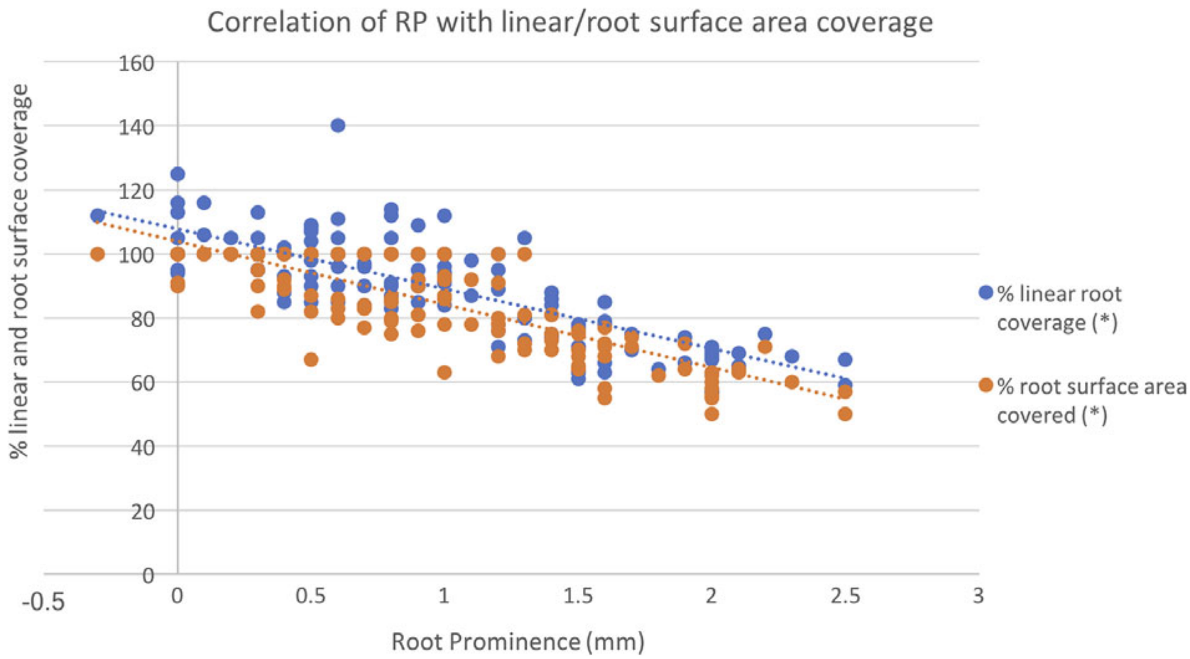

Figure 6

The initial gingival margin thickness showed a highly significant positive correlation with both linear root coverage (r = 0.70; P < 0.001) and root surface area coverage (r = 0.73; P < 0.001).

The results revealed a statistically significant negative correlation between initial recession depth and root surface area coverage (r = −0.27; P = 0.02). However, the correlation between initial recession depth and linear root coverage did not reach significance (r = −0.24; P = 0.1).

Initial recession width showed a statistically significant negative correlation with linear root coverage (r = −0.68; P < 0.001) and root surface area coverage (r = −0.67; P < 0.001).

When different graft materials were employed and the anatomic location of treated sites, that is, maxilla versus mandible were considered, no statistically significant correlations were observed with regards to the outcomes evaluated.

Second publication

Pubmed reference: Gil, A., Bakhshalian, N., Min, S., Nart, J., & Zadeh, H. H. (2019). Three-Dimensional Volumetric Analysis of Multiple Gingival Recession Defects Treated by the Vestibular Incision Subperiosteal Tunnel Access (VISTA) Procedure. International Journal of Periodontics & Restorative Dentistry, 39(5).

Title: Three-Dimensional Volumetric Analysis of Multiple Gingival Recession Defects Treated by the Vestibular Incision Subperiosteal Tunnel Access (VISTA) Procedure.

Authors: Alfonso Gil DDS, MS | Neema Bakhshalian DDS, MS, PhD | Seiko Min DDS, MS, PhD | José Nart DDS, PhD | Homayoun H. Zadeh DDS, PhD

Journal: The International Journal of Periodontics & Restorative Dentistry

Impact Factor: 1.22

Results of second publication

Quantitative digital analysis (linear gingival thickness and volume gain)

The linear gingival thickness gain values were 1.06 ± 0.30mm, 1.06 ± 0.36mm, 0.91 ± 0.30mm, 0.86 ± 0.30mm, and 0.83 ± 0.33 mm at 1, 2, 3, 4 and 5mm relative to the post-operative gingival margin, respectively (*Figure 7*). The gingival thickness gain at 1mm was higher than at 3mm ($p<0.0001$), 4mm ($p<0.0001$), and 5mm levels ($p<0.0001$); the gain at 2mm was higher than at 3mm ($p<0.0001$), 4mm ($p<0.0001$), and 5mm levels ($p<0.0001$).

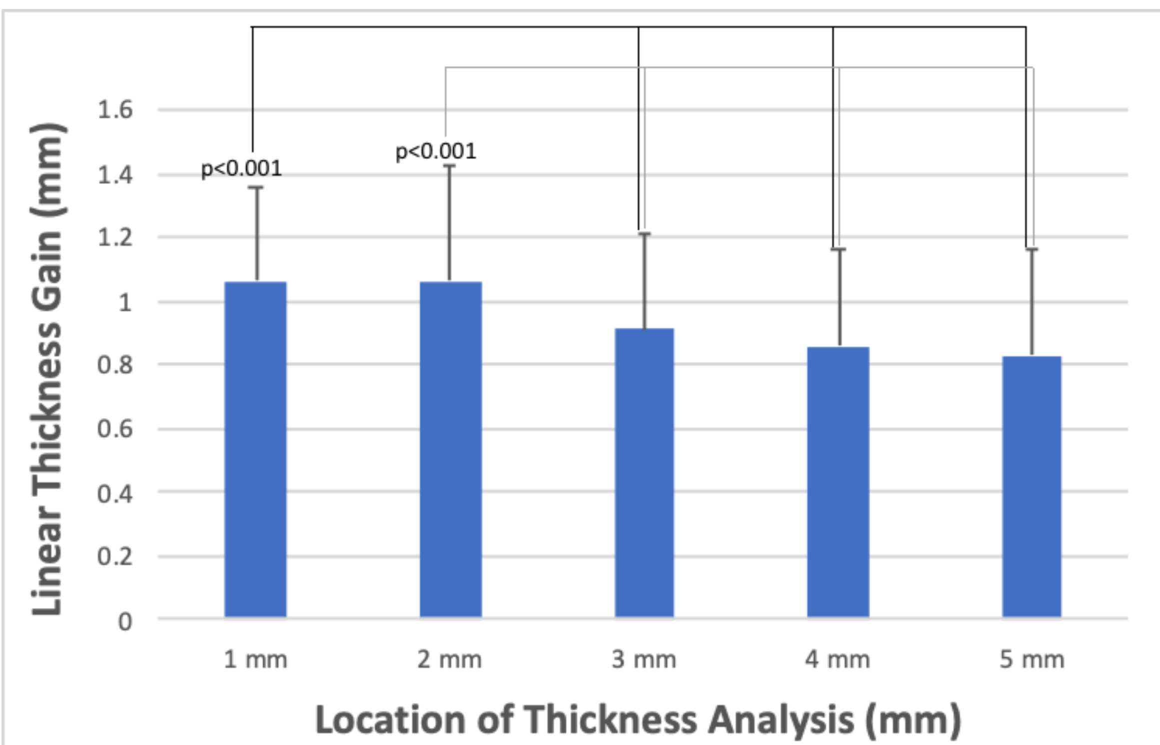

Figure 7

Recession defects located in the mandible showed significantly less linear thickness gain at 1mm and 2mm positions than those in the maxilla (p=0.01) (*Figure 8*). On the other hand, the total volume gained over the denuded roots of maxillary and mandibular teeth were not significantly different (p=0.73).

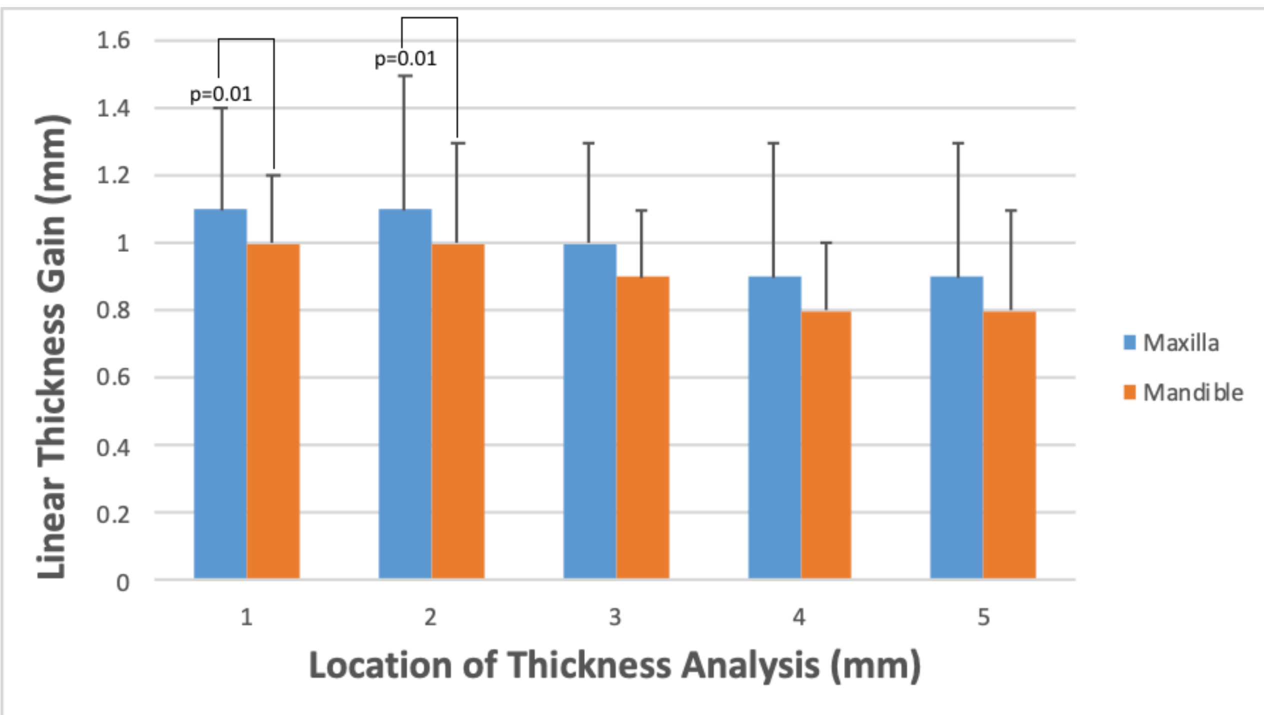

Figure 8

The mean volume gain among all treated sites was 5.47 ± 4.75mm3 and the mean volume gain among sites with Miller Class I-II (RT1) and Class III (RT2) recession defects were 5.15 ± 3.42mm3 and 6.05 ± 6.53mm3, respectively. The inter-group differences were not statistically significant ($p = 0.24$).

The initial root prominence exhibited a significant negative correlation ($R2=-0.18$) with linear thickness gain ($p=0.02$) combining the gain at 2, 3, 4, and 5 mm levels (*Figure 9*). Initial root prominence and volume gain did not show a significant correlation ($p=0.71$).

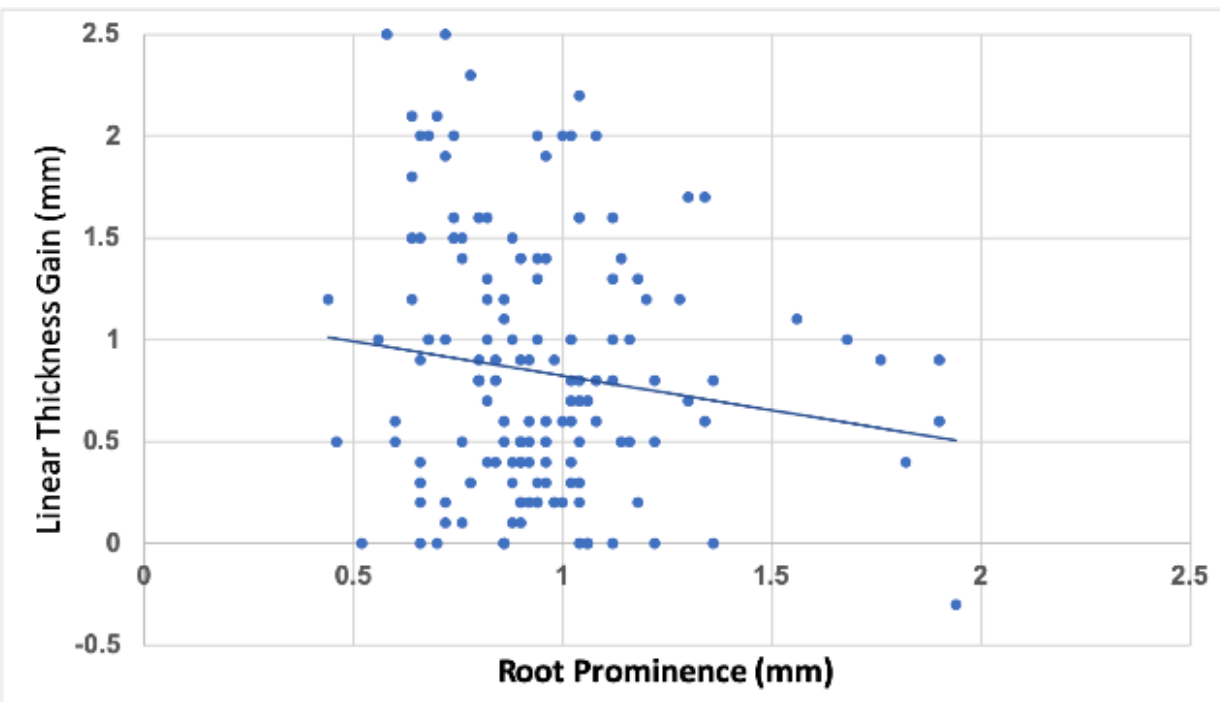

Figure 9

The results revealed a statistically significant positive correlation between initial recession depth and volume gain ($p<0.0001$), i.e. the deeper the recession, the more volume gain was obtained. A significant positive correlation was also observed between initial recession depth and thickness gain at the 5 different locations measured ($p<0.05$). Deeper recessions showed more thickness gain.

The thickness gain achieved using various graft material is shown in *Figure 10*. The thickness gain achieved depended on the location of analysis:

- At 1 mm depth from the final gingival margin was 0.92 ± 0.25mm for the palatal graft, 1.14 ± 0.34mm for the tuberosity graft, 1.03 ± 0.32mm for the ADM and 1.11 ± 0.17mm for the XCM;

- At 2mm depth was 0.99 ± 0.24mm for the palatal graft, 1.18 ± 0.41mm for the tuberosity graft, 0.95 ± 0.39mm for the ADM and 1.03 ± 0.22mm for the XCM;

- At 3mm depth was 0.88 ± 0.21mm for the palatal graft, 0.99 ± 0.36mm for the tuberosity graft, 0.84 ± 0.26mm for the ADM, and 0.92 ± 0.24mm for the XCM;

- At 4mm depth was 0.83 ± 0.25mm for the palatal graft, 0.92 ± 0.35mm for the tuberosity graft, 0.84 ± 0.29mm for the ADM and 0.82 ± 0.23mm for the XCM;

- At 5mm depth was 0.73 ± 0.21mm for the palatal graft, 0.90 ± 0.38mm for the tuberosity graft, 0.82 ± 0.36mm for the ADM and 0.79 ± 0.27mm for the XCM.

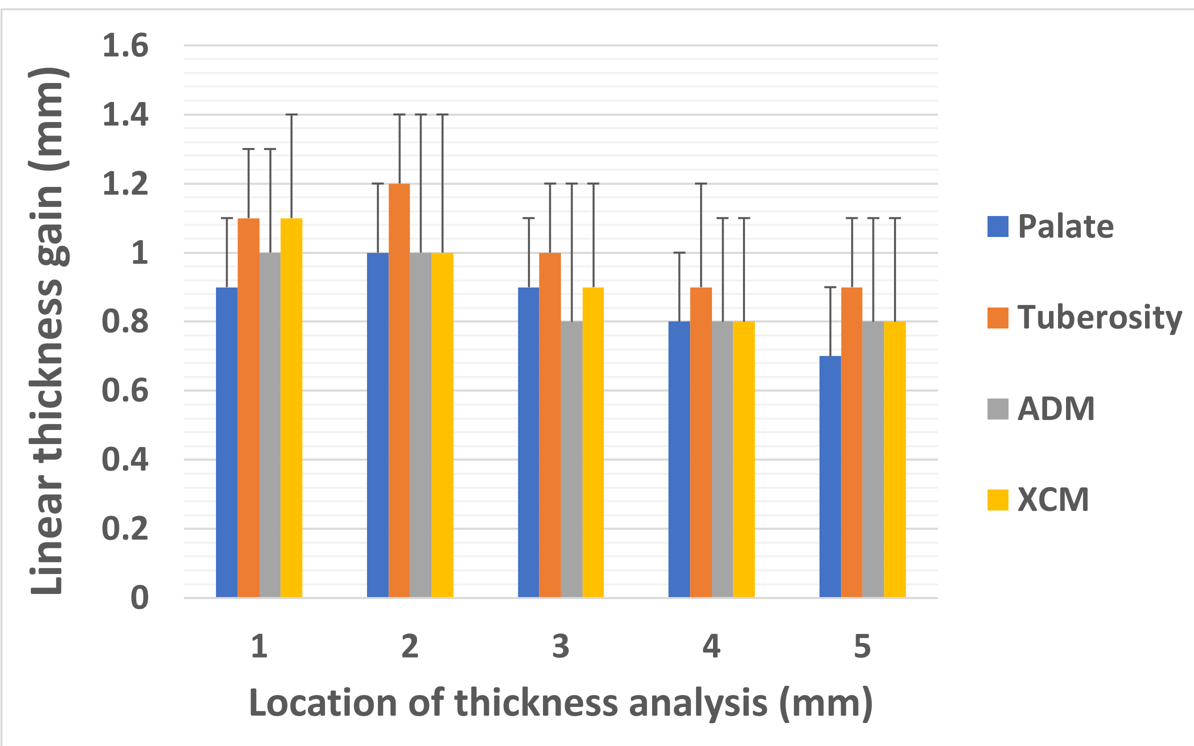

Figure 10

The type of graft material used did not lead to significantly different linear thickness (*Figure 10*) or volumetric (p=0.46) gain in any of the positions analyzed. Nevertheless, there was a trend for higher thickness gain with tuberosity connective tissue grafts.

Third publication

Reference: Gil, A., Nart, J., & Zadeh, H. H. Treatment of multiple recession defects with VISTA. Case report with vestibular incision subperiosteal tunnel access (VISTA) in combination with a sub-epithelial connective tissue graft. Inspyred: The alternative EAO voice | Volume 6, Issue 2: Winter 2018 | 04.

Title: Treatment of multiple recession defects with VISTA Case report with vestibular incision subperiosteal tunnel access (VISTA) in combination with a sub-epithelial connective tissue graft.

Authors: Alfonso Gil DDS, MS | José Nart DDS, PhD | Homayoun H. Zadeh DDS, PhD.

Journal: Inspyred: The alternative EAO voice.

Results of third publication

A detailed explanation of a complex case report that required a combination of periodontal treatment with root coverage and restorative treatment with porcelain veneers was presented.

The treatment plan included root coverage surgery with the VISTA technique combined with a palatal sub-epithelial connective tissue graft (SCTG) (*Figure 11*). Subsequently, the existing restorations (A) would be removed 12 months after the root coverage surgery and replaced with lithium disilicate porcelain veneer restorations.

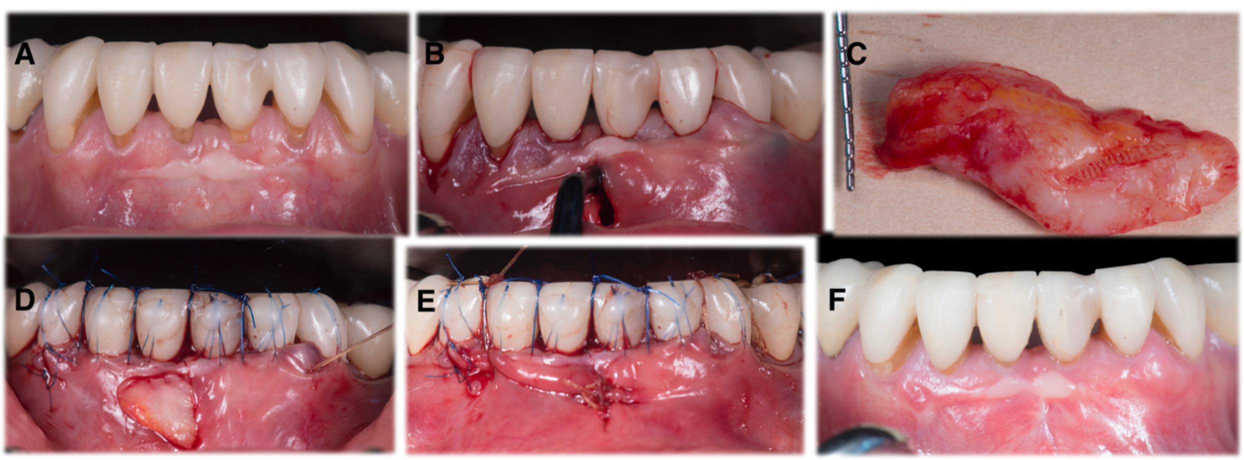

Figure 11

A full thickness vertical incision was performed at the end of the vestibule in the mucosal midline of the anterior mandible (B).

Through this incision, a sub-periosteal tunnel was elevated mesiodistally to cover all the teeth with recessions (33–44). At first, the tunnel was elevated in the mucosa and after passing through the mucogingival junction it was continued to the attached gingiva. The tunnel was finally extended from the gingival margin to the vestibule and connected in one single plane of dissection (B). The tunnel was elevated to include each of the papillae, in order to be sufficiently released to advance the mucogingival complex coronally in a tension-free manner.

Single simple interrupted sutures (6.0 polypropylene) were positioned 2–3mm apically from the gingival margin and double knots were secured in position. Each of the sutures was pulled coronally until the gingival was 1–2mm coronal to the restorative margin. In this position each of the sutures was bonded with flowable composite to the buccal surface of the porcelain veneers and light cured (D).

After the coronal advancement of the tunnel, a sub-epithelial connective tissue graft (SCTG) was harvested from the posterior lateral palate. The graft was 8mm in height, 3mm in thickness and 22mm in length (C). The graft was then positioned in place within the tunnel through the vertical incision, with mesial and distal sutures secured to the underlying flap from canine to canine. The vertical incision was then approximated with resorbable sutures (5.0 PGA)(E). The 12-month results (*F*) show that the mean root coverage achieved was 93% for all teeth with Miller Class III (RT2) gingival recessions (33–44). Complete root coverage was achieved in four out of seven teeth (57%). The gingival thickness was increased and the tissue remained stable during a one-year follow-up.

At this stage, the patient expressed some concerns about the scar in her midline result of a free gingival graft surgery performed many years ago. A minor gingivoplasty was performed to reduce the size and surface texture of the scar. Two months after the plasty, the new porcelain veneer restorations were delivered. The patient was very satisfied with the aesthetic results of the root coverage procedure and the new porcelain veneers (*Figure 12*).

Figure 12

The present case report demonstrated that the VISTA technique combined with an SCTG from the palate can provide predictable root coverage results which remain stable one year after, even in cases involving multiple recession defects with interproximal attachment loss (Dandu et al., 2016; Gil et al., 2018).

Discussion

First objective (first article)

The present study was undertaken to examine through digital analysis the outcome of periodontal root coverage for the treatment of multiple gingival recession defects. Initial site-specific characteristics, such as root prominence, recession depth and width, loss of interdental tissue (Miller Class III = RT2), as well as posterior tooth type, demonstrated a negative predictive value on the root coverage achieved. Conversely, initial gingival margin thickness was associated with increased percentage of root coverage.

The high degree of root coverage achieved in the present study may be potentially attributed to the coronal advancement of the gingival margins beyond the CEJ, as well as maintaining such position by the coronal anchorage using bonded sutures. The significance of coronal advancement of gingival margins during surgery has been previously demonstrated (Pini Prato et al., 2005, Richardson et al., 2015). Our study showed a mean of 96% and 84% root coverage for Miller Class I/II (RT1) and III (RT2) recession defects, respectively. The results for Class III are consistent with other publications, showing high degree of root coverage on Miller Class III (RT2) recession (Aroca et al., 2010, Cairo et al., 2012, Henriques et al., 2010). These reports have cited the significance of coronal advancement of midfacial tissues in conjunction with a CTG. However, complete root coverage in Class III defects proved to be more challenging, showing inferior results (22.2%) than the aforementioned publications.

Experienced clinicians realize that root prominence is an important risk factor in achieving complete root coverage (Wennström et al.., 2003, Saletta et al., 2005). However, scientific data supporting this clinical impression is scarce, because of the difficulty in its assessment. The present work is in agreement with a previous study (Santamaria et al., 2010) that described the possible negative influence of root convexity on flap adaptation and suture tension. The results of the present study showed a negative correlation between root prominence and root coverage outcomes. Notably, root coverage decreased significantly in sites with greater than 1 mm of initial root prominence. All treated sites were subjected to scaling and root planing, as well as odontoplasty during surgery to reduce their prominence. However, the removal of root convexity with odontoplasty could not be quantified. The effect of root prominence could, therefore, be more negative if left untreated. Its therapeutic reduction through odontoplasty should be investigated in future studies.

The majority of the randomized clinical trials published on mucogingival surgery for root coverage focus on maxillary canines and premolars (Buti et al., 2013). Only a few studies have examined other tooth types, such as molars, with varying degrees of success, ranging from 74% to 91% of root coverage (Zucchelli et al., 2012, Harris et al., 2003). The present study has shown that tooth type may be an important predictive factor for root coverage. Posterior teeth yielded lower root coverage than anterior teeth. This may be the result of a greater area of denudation in multirooted teeth with a higher avascular surface to be covered.

Several studies have correlated greater flap thickness at different depths to improved clinical outcomes following root coverage (Baldi et al., 1999, Berlucchi et al., 2005) and thus have identified flap/gingival thickness as a prognostic factor in the treatment of gingival recession defects (Hwang et al., 2006). In a recent study, flap thickness was only a predictor of root coverage when coronal advancement was performed without additional graft (Garces-McIntyre et al., 2017). When CTG was added in conjunction with coronal advancement, flap thickness was not correlated with complete root coverage.

In the present study, the gingival marginal thickness was used as the reference point, because the digital surface scan cannot distinguish the thickness of the flap. When the preoperative gingival marginal thickness was more than 1 mm, the percentage of root coverage was higher. Because of the simplicity in its assessment, gingival margin thickness may be utilized in further studies as a noninvasive potential surrogate measurement for flap thickness.

Second objective (second article)

The present study exploited 3-dimentional digital analysis to quantify linear and volumetric gingival thickness gain. Treatment of gingival recession defects with VISTA, in combination with various graft materials, lead to root coverage over previously denuded root surfaces, as well as increased tissue thickness. Certain site-specific factors, such as initial root prominence, recession depth and arch location may influence the outcomes.

Three-dimensional analysis enabled the examination of parameters, which cannot be clinically assessed. Some studies have successfully used 3D digital analysis to examine changes in alveolar bone and mucosa following tooth extraction (Chappuis et al., 2015, Zadeh et al., 2016, Abdelhamid et al., 2016) and buccal deficiencies around implants (Naenni et al., 2018). On the other hand, studies using digital 3D analysis of soft tissue augmentation on teeth are scarce (Gil et al 2018., Schneider et al.., 2014, Rebele et al., 2014). The present data showed that the gingival volume gain achieved by soft tissue augmentation around sites with RT1 and RT2 were not significantly different. This is an important observation, because it can potentially influence decision making for the treatment of RT2 cases. It is commonly considered that root coverage therapy is not predictable in RT2 and RT3 cases. This often leads some clinicians not to attempt root coverage therapy for RT2 and RT3 cases. The observation that the gingival thickness volume gain in RT1 and RT2 cases were not different suggests that soft tissue augmentation may be equally efficacious in RT1 and RT2 cases.

Moreover, a statistically significant positive correlation between initial recession depth and volume gain was observed. This implies that greater volume gain was achieved in deeper recession sites. This is contrary to previous observation that the efficacy of root coverage declines with increasing recession depth, in particular in sites with greater than 4mm of recession (Tatakis et al., 2015).

Increasing gingival thickness has been shown to be an important factor, with several studies correlating flap thickness to root coverage (Baldi et al., 1999, Berlucchi et al., 2005). The gingival thickness gain measured in the present study ranged from 0.8 to 1mm. This compares favorably to previous studies, such as by Woodyard (Woodyard et al., 2004), where coronal advancement did not lead to measurable thickness change, but coronal advancement plus acellular dermal matrix yielded 0.4mm of thickness gain. In addition, the greater thickness gain coronally can be explained by the fact that the grafts were always sutured at the most coronal locations of the tunnel.

Root convexity is a site-related factor that per se might influence the clinical outcome of root coverage procedures (Santamaria et al., 2010, Gil et al., 2018). However, scientific data supporting this consideration is scarce, due to the difficulty in its assessment. The part of the root that is outside of the gingival housing can be considered as root prominence (Saletta et al., 2005). The negative correlation between root prominence and root coverage was recently reported (Gil et al., 2010). The results of the present study have demonstrated a negative correlation between root prominence and linear thickness gain. This may be an important risk assessment consideration prior to root coverage therapy. Although odontoplasty was performed on all sites treated in this study, root prominence remained negatively correlated with gingival thickness gain. It will be important that future studies quantify the degree of odontoplasty performed in order to determine whether it can reduce the negative influences of root prominence.

Different types of graft material were used in the study. Autogenous grafts from different donor sites may have different characteristics and different clinical indications (Zuhr et al., 2014, Sanz-Martín et al., 2019). The clinical decision of where to harvest depends on the availability of tissue and surgeon preference and is hardly based on written evidence. Soft tissue substitutes (allogenic or xenogenic) have been employed to reduce patient morbidity and have shown promising results (Thoma et al., 2018).

Nevertheless, their added clinical value for soft tissue augmentation needs further investigation (Vignoletti et al., 2014). Systematic reviews (Buti et al., 2013, Chambrone et al., 2015) consider the sub-epithelial connective tissue graft to be the gold standard for root coverage procedures since it has shown the most stability in gingival thickness (Cortellini et al., 2012). The results of the present study showed a clinical trend (with no statistical significance) towards higher thickness gain with the use of a tuberosity connective tissue graft. This tissue has been described to be dense with more collagen and less adipose and glandular tissue and may therefore undergo less shrinkage (Zuhr et al., 2014).

It has been reported that significantly greater improvements of recession depth were observed in maxillary multiple recession defects treated with connective tissue grafts in combination with a coronally advanced flap compared with similar mandibular defects (Chambrone et al., 2008). When maxillary and mandibular sites were compared in this study, maxillary recessions showed greater thickness gain at the most coronal depths. The muscle pull and the decreased thickness of the gingiva in the anterior mandible could negatively affect the outcome of mucogingival surgery.

Limitations

The present study had a number of limitations, including: (1) the retrospective nature of the study did not include a control group and had a limited sample size; therefore, it is not possible to determine whether the thickness gain is unique to VISTA or can be achieved with other methods; (2) the location of the interdental papillae could not be consistently discerned from the scanned study casts; therefore, a quantitative measurement of the change of the position of interproximal tissue could not be performed; (3) an esthetic analysis could not be performed because of the retrospective nature of the study and the digital analysis; (4) the average recession depth was shallow, because VISTA generally encompassed a large treatment zone and some of the teeth in between and in adjacent areas that had relatively minor recession were included in the therapy (the rationale of extending VISTA tunnel to adjacent areas was to create a harmonious gingival margin); and (5) the analysis of surface-scanned images only revealed thickness changes, rather than true mucosal thicknesses.

Nonetheless, the present study methodology offered important advantages: (1) the sensitive 3-dimensional image analysis conducted, ensured that the same region of interest was compared at preoperative and postoperative time points; (2) new parameters were examined in the present study, which are generally hard to measure clinically, for example, root prominence and gingival margin thickness; and (3) inclusion of patients encountered routinely in clinical practice with a wide range of presentations made this study more relevant to clinical practice.

The findings of the present study warrant a prospective randomized controlled clinical trial to address the aforementioned limitations and corroborate the predictive value of the parameters identified.

Future perspective

The management of complex periodontal cases, with multiple recession-type defects with interproximal attachment loss, is still a clinical challenge nowadays. This is still a gray area of research, since the literature cannot yet provide a clear answer as to how to handle these cases in a predictable manner.

New techniques with no surface incisions and minimally-invasive approaches may help in the resolution of such complex cases. VISTA technique in combination with various graft materials has demonstrated that root coverage and gingival volume gain is possible, even in multiple gingival recession cases with loss of interproximal support. Prospective randomized clinical studies should be performed to confirm these findings in both Cairo RT1 and RT2 recession defects.

The proper assessment of certain anatomical factors is of key importance to predict the outcome of periodontal root coverage therapy. A good understanding of what predictive factors may aid or limit root coverage allows the clinician to know which cases to treat and which not to treat, as well as to explain the patient what can be expected from the mucogingival surgery. The present study has suggested some site-specific characteristics, like root prominence, tooth location, arch location, gingival margin thickness and recession depth, that exert an influence of the outcomes of root coverage and gingival volume gain. Due to the retrospective nature of the study, no causality can be established for any of these factors. However, such findings shed light as to where to focus for future prospective studies, whose design will allow a cause and effect relationship for the parameters studied.

Evidence for coverage of peri-implant mucosal recessions is limited, and although some studies have demonstrated that mucosal coverage is possible (Burkhardt et al., 2008, Roccuzzo et al., 2014, Zucchelli et al., 2013), their management and long-term stability is still unknown.

Since the mucosal margin of the implant is the most critical part while performing mucosal dehiscence coverage, techniques that offer a remote surgical access from this area should be investigated. A vestibular access to the implant through a tunnel (VISTA) could therefore provide a means to obtain predictable peri-implant mucosal coverage as well as an increase in soft tissue thickness. The tunnel can be elevated through the vertical vestibular incision, far away from the peri-implant mucosal margin, and the graft material can also be inserted and secured through such incision. In this way, coronal advanced of the mucosa together with soft tissue thickness gain can be achieved without traumatizing the mucosal margin.

It is the objective of the authors to design a prospective trial where this technique can be tested for efficiency and predictability on implant recessions.

Conclusions

1) Three-dimensional analysis provides a useful method for evaluating the outcome of periodontal plastic surgery.

2) The results of the present study showed root coverage, gingival thickness and volumetric gain achieved with VISTA in combination with different graft materials.

3) Certain site-specific factors exerted an influence of the outcomes of root coverage and gingival volume gain.

4) Initial site-specific characteristics, such as root prominence, loss of interdental tissue (Miller Class III = RT2), initial recession depth, as well as posterior tooth type, demonstrated a negative predictive value on the outcome of periodontal root coverage achieved. Conversely, initial gingival margin thickness was associated with increased percentage of root coverage.

5) Root prominence and mandibular arch location showed a negative predictive value on the outcome of linear gingival thickness gain. The type of graft material used did not affect the gingival thickness or volume gain.

Attachments

Attachment 1: Book Chapter

Pubmed reference: Zadeh, H. H., & Gil, A. (2020). Coronally Positioned Flaps and Tunneling. In Advances in Periodontal Surgery (pp. 137-155). Springer, Cham.

Title: Coronally Positioned Flaps and Tunneling.

Authors: Alfonso Gil DDS, MS | Homayoun H. Zadeh DDS, PhD.

Journal: Advances in Periodontal Surgery.

Book Chapter

1-Introduction

Patients often present with a variety of soft tissue defects around teeth and implants that can lead to functional and esthetic problems. An array of surgical procedures has been developed to manage these soft tissue defects. The initial procedures were mainly respective in nature and aimed at correcting aberrant frenum attachments, shallow vestibules and inadequate attached gingiva and were collectively referred to as “mucogingival surgery” (Friedman et al., 1957).

In recent years, surgical procedures to deal with soft tissue deficiencies have been refined and have incorporated regenerative therapies, as well as adopted the goal of esthetic enhancement. This broadening of the range of surgical procedures lead to the introduction of “periodontal plastic surgery”, as a new term coined by Miller (Miller et al., 1993). Soft tissue abnormalities could be treated in a predictable manner, improving both soft tissue health, function and esthetics (McGuire 1998).

2-Scope of the problem: how common is gingival recession?

Gingival recession is characterized by apical migration of the gingival margin from the cementoenamel junction (CEJ), with concomitant exposure of the root surface. The root exposure associated with gingival recession can have negative esthetic sequelae, as well as predispose the site to dentinal hypersensitivity and root caries (Chambrone et al., 2010).

The prevalence of gingival recession can vary substantially among the specific study populations. In North America, it has been described in one epidemiological study in 78-100% of middle-aged individuals, potentially affecting 22-53% of the teeth (Gorman 1967). In another study, the prevalence of 1 mm or more recession in American population aged 30 years and older was 58% and increased with age (Albandar et al., 1999). In Brazil, a more recent study showed that 89% of the adults presented with gingival recession (Marini et al., 2004). In addition, other epidemiological studies demonstrated that adult subjects showed a prevalence of gingival recession of 51% in Norway (Sangnes et al., 1976) and of 68% in Finland (Vehkalahti et al., 1989). Overall, gingival recession is a highly prevalent condition, which progressively increases with age.

3-Etiology

The identification of potential etiological factors in the induction of gingival recession is critical in managing those risk factors in the course of therapy. The literature has described many possible factors, though their causality has not been established. Anatomical, physiological, pathological disease-related, and mechanical factors have been suggested (Kassab et al., 2003, Zucchelli et al.., 2015).

Periodontal or tooth anatomy can play a role in the apical migration of the gingival margin. Inadequate zone of attached gingiva, high frenum or muscle insertions, tooth mal-alignment, and excessive root prominences are believed to predispose to the development of recession. Ectopic positioning of roots outside of the alveolar bone envelope, following orthodontic tooth movement, may also lead to gingival recession. Mechanical trauma encompasses various forms of injury to the tissue, including improper tooth brushing, intraoral piercings, prosthetic appliances, overhanging restorative margins, invading the biologic width, and tobacco chewing. Pathologic conditions, such as inflammation associated with periodontitis, leads to apical migration of periodontal attachment resulting in gingival recession. Successful therapy is predicated on effective removal of the causative factors prior to any periodontal plastic procedure to avoid recurrence.

4-Risk assessment

In addition to the etiological factors, there are certain patient and site related factors that can put patients at a greater risk for developing gingival recession. Increased age, male gender, high plaque index, tobacco smoking and number of missing teeth are patient related factors that have been associated with the extent and severity of gingival recession (Susin et al., 2004, Sarfati el at., 2010). Malpositioned teeth (rotated or too buccally/lingually inclined), teeth with a thin gingival biotype, with excessive frenum pull, with advanced periodontal disease, and/or with subgingival restorative margins have also been correlated with a higher possibility of gingival recession.

Although each of these factors have been associated with gingival recession, the presence of multiple factors may significantly increase the risk of developing or exacerbating gingival recession. Therefore, risk assessment should consider each of the elements of risk, as well as the number of risk indicators identified in order to develop an effective strategy to mitigate those risks.

5-Classification of gingival recession defects

Different classification systems have been used throughout the years to describe gingival recession. Initial attempts at classification, measured recession width and depth, to classify recession into four categories, using the descriptive terms “shallow”, “deep”, “narrow” and “wide” (Sullivan and Atkins 1968a). The Index of Recession (IR), was later introduced and was mainly used in cross-sectional and longitudinal epidemiologic studies to describe the prevalence, incidence, and severity of gingival recession (Smith 1997). It categorized recession by two digits, separated by a dash, such as “F3-6”. The letters F or L referred to facial or lingual recession, respectively. The digits denote the horizontal width and vertical height of the recession. The classification proposed by Miller is currently the most widely-used classification (Miller 1985). This system is based on vertical soft tissue loss in relation to the mucogingival junction (MGJ), as well as the level of interproximal periodontal tissue loss. It categorizes defects into four classes. Miller Class I describes gingival recession, which ends coronal to the MGJ, whereas the denuded root defect extends to the MJG in Class II. The interproximal attachment and bone is intact in Class I and II gingival recession defects, while it is mild/moderate in Class III and severe in Class IV, extending beyond the midfacial recession. Miller correlated the classification to the expected prognosis of root coverage, where complete root coverage was predicted in Class I and II, while only partial root coverage was expected in Class III defects, and unpredictable outcome was anticipated in Class IV sites.

The scientific community has expressed some doubts of this classification system, including the uncertainty of the amount of interproximal attachment loss, the unknown influence of tooth malposition and the difficult distinction between Class I and II gingival recession. To solve such limitations, Cairo and collaborators have introduced a new classification system, based on the identification of the interproximal clinical attachment level to predict the outcome of therapy (Cairo et al., 2011). Three recession categories were described in this classification: RT1, exhibiting no interproximal attachment loss; RT2 showing interproximal attachment loss equal or less than the facial defect; RT3 presenting with interproximal attachment loss greater than the facial defect.

The degree of facial root coverage anticipated by the RT classification was projected to be limited by the interproximal attachment level. Therefore, root coverage has been suggested to be more predictable in RT1 and RT2 than RT3.

6-Rationale for therapy

Progression of gingival recession with or without therapy

Multiple lines of evidence have suggested that gingival recession defects are progressive in nature. In a longitudinal with 12-year follow-up, demonstrated that, gingival recession increases with age and sites with existing gingival recession are at the greater risk of progression of the recession (Serino et al.,. 1994). In a retrospective 10- to 27-year follow-up split-mouth study, gingival recession defects, lacking attached gingiva treated with free gingival graft on one side of the mouth, were compared with untreated contralateral sites (Agudio et al., 2009). Results demonstrated that treatment was effective, since all treated sited exhibited reduced gingival recession and increased stable keratinized gingiva. In contrast, untreated sites showed increased gingival recession during follow up period.

Systematic review and meta-analysis of untreated gingival recession defects have indicated increased risk of progression of recession during long-term follow-up (Chambrone and Tatakis, 2016). There is also some limited evidence to support a protective role for keratinized gingiva in reducing the likelihood of gingival recession progression. As a result, the surgical correction of these defects via soft tissue augmentation and root coverage appears as an important intervention to be considered during the clinical decision-making process.

There are four main indications for the surgical treatment of gingival recession i) esthetic purposes, ii) to augment a deficient keratinized tissue, iii) to reduce dentinal hypersensitivity, and iv) to correct root abrasion defects or caries (Roccuzzo et al., 2002; Chambrone et al., 2009; Cairo et al., 2008).

i) Esthetic reasons

The main reason that drives many patients to seek periodontal treatment is esthetic concerns. Patients demand treatment when excessively long teeth and/or a lack of harmony in the gingival margins are evident while smiling. The most feasible treatment to correct this esthetic gingival imbalance is root coverage procedure. A recent systematic review of randomized controlled trials has demonstrated that periodontal plastic surgery procedures for the treatment of single and multiple gingival recessions improve esthetics, both perceived by patients, as well as objectively assessed by professionals (Cairo et al., 2016).

ii) Hypersensitivity

Teeth with gingival recession often experience pain in response to thermal, chemical and tactile stimuli to the exposed dentine. This phenomenon is known as “dentinal hypersensitivity”. The pain is commonly sharp, short and localized and can severely affect performance of proper oral hygiene. The treatment for dentinal hypersensitivity can be complex and may include local application of desensitizing agents to occlude exposed dentinal tubules for mild cases with no esthetic concern. Cervical restoration has been performed in cases where there has been enamel loss, exposing dentine coronal to the CEJ. Surgical intervention to achieve root coverage is another strategy, primarily indicated when complete root coverage can be predicted. A systematic review has suggested that there is not enough evidence to prove that mucogingival can resolve dentinal hypersensitivity (Douglas de Oliveira, et al., 2013).

This is attributed to the fact that dentinal hypersensitivity has not been consistently evaluated in clinical studies. Nonetheless, several studies have demonstrated improvement in dentinal hypersensitivity. One reason why dentinal hypersensitivity is not consistently resolved is because incomplete root coverage can be associated with residual dentinal hypersensitivity. Therefore, root coverage can be proposed as a viable therapeutic option for patients who complain of dentinal hypersensitivity, only if complete root coverage is technically feasible.

iii) Keratinized tissue augmentation

Gingival recession defects with thin, minimal or no keratinized gingiva have been considered to be at greatest risk of progression (Wennstrom and Zucchelli 1996). Therefore, keratinized tissue gain has been considered one of the therapeutic objectives of periodontal plastic surgery. However, it may be debatable whether gingival thickness or the keratinized phenotype of the gingiva are the most important elements of risk. The fact that many types of grafting, which do not necessarily mediate clinically significant increase in keratinized gingival zone are associated with periodontal attachment level stability may argue that gingival margin thickness is more important than keratinization phenotype. Moreover, some of the therapies aimed at increasing keratinized gingival zone, such as free gingival graft are associated with diminished esthetics, suggest a secondary role for keratinized gingiva in periodontal plastic surgery.

iv) Cervical caries and non-carious cervical lesions

In the elderly population, radicular caries and/or deep root abrasion are common findings and can pose oral hygiene challenges for patients (Takano et al., 2003). These can lead to dentinal hypersensitivity and/or endodontic involvement. The combination of root coverage surgery and restorative treatment in these teeth can help prevent future caries development and render an easier situation for plaque control for the patient. However, one may consider that dentinal bonding is not as predictable as enamel bonding.

Therefore, bonded restorations in dentin may be more prone to leakage or failure.

7-Techniques for gingival recession therapy

Multiple approaches to the treatment of gingival recession defects have been described in the literature, including Coronally Advanced Flap (CAF) with or without additional graft, Intra-Sulcular Tunneling (IST), Pedicle flaps, Free Gingival graft (FGG), guided tissue regeneration (GTR) and vestibular incision subperiosteal tunnel access (VISTA).

(i) Free Gingival graft

A number of investigators have pioneered the technique of free gingival graft (Bjorn 1964), as well as its application for vestibular extension (Nabers 1966a), root coverage (Nabers 1966b) and for pre-prosthetic augmentation of attached gingiva (Haggerty 1966). In 1968 Sullivan and Atkins (Sullivan and Atkins 1986b) outlined the biologic basis of FGG and the wound healing process, subsequent to FGG therapy.

The advantages include, increase in zone of keratinized attached gingiva and vestibular depth. The disadvantages include limited ability for root coverage, mismatch of surface contour, texture and color, which result in compromised esthetics.

(ii) Coronally Advanced Flap

CAF is perhaps the most documented procedure for the treatment of single and multiple gingival recession defects. Norberg is credited as describing a procedure that involved coronal positioning of gingiva. Bernimoulin was the first to report on CAF in 1975 for the treatment of gingival recessions (Bernimoulin et al., 1975). This procedure has undergone a number of refinements, including by Allen and Miller in 1989 (Allen et al., 1989), Pini Prato et al., in 1992, by Zucchelli and De Sanctis in 2000 and De Sanctis & Zucchelli in 2007. CAF has been performed either without additional graft, subsequent to FGG, in conjunction with a barrier membrane as GTR and most commonly along with SCTG.

The coronally advanced flap for the treatment of single-tooth recession defects is designed with two horizontal beveled interproximal incisions on each side of the recession defect (De Sanctis & Zucchelli in 2007). The incisions are made at a level which measures the recession depth plus 1mm apical to the papillae tips. Additionally, two relatively short beveled vertical releasing incisions are made. These incisions, which are elevated by partial thickness dissection, start coronally at the lateral ends of the horizontal incisions and extend apically to the alveolar mucosa. A trapezoid-shaped flap is elevated, starting with partial thickness dissection of the surgical papilla. Full thickness flap elevation of the soft tissue apical to the gingival recession zenith is carried out to approximately 3mm apical to the bone dehiscence. Partial thickness flap elevation is carried out to mobilize the flap in order to coronally position the flap with minimal tension. The papillae are de-epithelialized in order to create a vascular bed for the elevated flap which will be sutured coronal to the CEJ in the papillae, using sling sutures.

To treat multiple recession defects, interdental submarginal incisions and an envelope flap using split–full–split is employed (Zucchelli and De Sanctis 2000). The flap is extended at least one to two teeth on either side of the affected teeth to allow for low-tension coronal advancement of the flap. This technique offers many advantages, including, the ability to treat single, as well as multiple recession defects.

CAF provides good access to the treatment site, allowing the operator the flexibility to perform full-, as well as partial-thickness flap in an effort to reduce the flap tension for optimal coronal advancement. The main drawbacks of this technique include the scar formation associated with the incision line (Zuhr et al., 2018). Previous studies have demonstrated that flap tension is a negative predictor of root coverage and procedures which reduce flap tension can lead to better root coverage. Similarly, positioning of the gingival margin at least 2mm coronal to the CEJ can lead to increased likelihood of achieving complete root coverage (Pini Prato et al., 2005). One of the major risk factors for root coverage outcome is flap thickness (Baldi et al., 1999). In cases where flap thickness is less than 0.8mm, there is decreased likelihood of root coverage. In a recent prospective clinical study, it has been demonstrated that flap thickness was a negative predictor of root coverage only in those cases where CAF was performed without additional graft (Garces-McIntyre et al., 2017). In cases where SCTG was used in conjunction with CAF, flap thickness was not a risk factor. Therefore, clinicians can use this information to mean that in cases with thin mucosa, additional grafting may be utilized.

(iii) Intra-Sulcular Tunneling (IST)

In 1985, Raetzke, pioneered the "envelope" flap that was created by partial thickness dissection for covering localized areas of root exposure (Raetzke 1985). The envelope flap was formed by undermining partial thickness incision in the tissues surrounding the defect and a free SCTG was positioned directly over the root dehiscence. In 1994, Allen offered a modification of the Raetzke envelope by creating a partial thickness supra-periosteal envelope for the treatment of multiple gingival recession defects (Allen, 1994). This approach entailed partial thickness undermining dissection through the papillae to allow for coronal advancement of the flap. In 1999 Zabalegui and collaborators coined "the tunnel" technique by offering a more detailed protocol (Zabalegui et al., 1999). This report outlined a strategy to undermine the papillae with partial thickness dissection through intra-sulcular incision without any surface incisions. The partial thickness dissection is carried out beyond the mucogingival junction, not to reposition the flap, but to allow for insertion of SCTG. Further refinements of the tunnel technique have been offered by coronal reposition of the gingival margin, using double-crossed sutures, which are slung over interproximal embrasures that are blocked with temporary bonded resin restoration (Zuhr et al., 2009).

Intra-sulcular tunneling has many advantages, including lack of surface incision, which can be less disruptive to the blood supply, potentially leading to faster healing and avoiding esthetic complications. However, the major disadvantages of this technique include, the technical challenges of working through the small sulcular area, particularly in cases with exostosis, potentially limiting the ability of flap release.

(iv) Vestibular Incision Subperiosteal Tunnel Access (VISTA)

The vestibular approach to soft tissue augmentation started with the semilunar coronally positioned flap technique (Tarnow 1986). The approach entailed a semilunar incision made parallel to the facial free gingival margin and coronally positioning this flap over the exposed root. The vestibular approach for bone augmentation has been described by several investigators (Block et al., 1987, Khoury 2006 ; Zadeh et al., 2008a). The vestibular incision and subperiosteal tunneling for soft tissue augmentation has also been reported (Zadeh, 2008b). The rationale and detailed protocol for VISTA for the treatment of multiple recession defects was described in 2011 (Zadeh, 2011). This approach entails thorough root instrumentation, including odontoplasty to remove portions of the root, which protrude beyond the gingival housing. Root prominence has been demonstrated to be negatively correlated with periodontal root coverage (Gil et al., 2018).

The advantages of VISTA, include avoidance of surface incisions near gingival margins or papillae, thus avoiding vascular disruption, esthetic complications and accelerating healing. Moreover, there is better access to the apical areas for low-tension flap release. The main disadvantage, includes potential scar formation in the location of vertical incision, though this is usually in an area, which is not readily visible.

(v) Guided tissue regeneration (GTR)

Barrier membranes have been utilized in guided tissue regeneration for periodontal regeneration. This concept has also been applied for the treatment of gingival recessions. GTR has had variable results, primarily as a result of potential complications of membrane exposure and infection. SCTG has been shown to be more effective than GTR for root coverage (Chambrone and Tatakis, 2015).

(vi) Orthodontic extrusion

Orthodontic tooth movement can modulate gingival position. In particular orthodontic extrusion may be employed to coronally reposition gingival margin position (Borzabadi-Farahani and Zadeh, 2015). This will require slow application of orthodontic forces at a rate of 1mm or less per month.

8-Material selection

An array of different material is used for the treatment of gingival recession defects, including donor tissue (autologous, allogenic and xenogenic), Enamel Matrix Derivative (EMD), Xenogenic Collagen Matrix (XCM), recombinant growth factors, autologous platelet concentrates and living cell constructs (LCC).

(i) Donor-derived tissue

Donor tissue have included skin graft (Schnitzler and Ewald, 1894), epithelialized palatal graft (Sullivan and Atkins, 1968), subepithelial connective tissue graft from palate or tuberosity (Sanz-Martín et al., 2018), acellular dermal matrix (ADM) allograft (Gapski et al., 2005, Kroiss et al., 2019) and xenogenic dermis (Vincent-Bugnas et al., 2018). In a comparative study to examine the composition of autologous mucosal grafts harvested from the lateral palate or the tuberosity, it has been shown that tuberosity grafts have more lamina propria and less submucosa (Sanz-

Martín et al., 2018). The tuberosity has been demonstrated to have SCTG composition which is best suited for volume augmentation.

(ii) Xenogenic Collagen Matrix (XCM)

In an attempt to find viable alternatives to human donor-derived autogenous and allogenic graft material, XCM has been developed. There are both native (Camelo et al., 2012) and cross-linked (Thoma et al., 2016) XCM material, each of which has advantages and disadvantages. Native collagen may be applied to recipient sites, prepared by partial thickness dissection and allowed to heal in an exposed manner, similar to FGG (McGuire and Scheyer 2014). In that capacity, available data indicate favorable augmentation of both width and thickness of the zone of keratinized tissue (Thoma et al., 2011; Vignoletti et al., 2011; Thoma et al., 2010). Native porcine XCM has also been employed in conjunction with coronal advancement flap (Schlee et al., 2014, Tonetti et al., 2018), as well as VISTA (Tatakis, et al. 2015) with favorable outcomes. In a large multi-center randomized clinical trial, comparing CTG to native XCM, it was demonstrated that autogenous CTG had higher probability of achieving complete root coverage. However, the degree of root coverage were 1.7 ± 1.1 mm for CMX and 2.1 ± 1.0 mm for CTG. Therefore, the difference between the two groups was only 0.4mm.

Moreover, surgical time was 15.7 min shorter, the procedure was perceived to be lighter by patients and the recovery time was 1.8 days shorter for XCM, compared to CTG.

Volume-stable cross-linked collagen matrix (VCMX) has been developed to increase mucosal thickness (Thoma, et al 2016; Ferrantino, et al. 2016). VCMX is intended to be applied in submerged fashion. Results have demonstrated that the thickness gain with VCMX and CTG are equivalent (Thoma, et al 2016; Ferrantino, et al. 2016).

(iii) Enamel Matrix Derivative (EMD)

A large body of clinical and experimental evidence has demonstrated that enamel matrix proteins (EMPs) mediate periodontal regeneration. EMPs have been exploited therapeutically, through the use of enamel matrix derivative (EMD), which are clinically available as Emdogain. Treatment of gingival recession has been conducted with EMD plus CAF, not only to cover the roots but also to mediate periodontal regeneration (Rasperini, et al 2000). There is available animal and human histologic evidence to demonstrate the re-formation of true periodontal regeneration with new bone, new PDF, new cementum and functional fibers (Rasperini, et al 2000). Randomized controlled studies have also demonstrated a mean root coverage of 84% to 94% (Cairo, et al. 2014). Clinical trial data have demonstrated that, compared with CAF alone, CAF plus EMD yields increased root coverage, as well as keratinized gingiva width (Cairo, et al. 2014).

(iii) Autologous Platelets

Several generations of autologous platelet concentrate, along with various other components of blood (fibrin, leukocytes) have been utilized, using different protocols. These have included Platelet Rich Plasma (PRP), Platelet Rich Growth Factor (PRGF) or Platelet Rich Fibrin (PRF). Each of these can also include leukocyte, eg. Leukocyte-Platelet Rich Fibrin (L-PRF).

There are mixed results, when L-PRF has been used in conjunction with CAF (Castro, et al. 2017). Comparison of L- PRF to SCTG by meta-analysis has demonstrated similar outcomes, namely, PD reduction (0.2, 0.3 mm, $p > 0.05$), CAL gain (0.2, 0.5 mm, $p > 0.05$), KTW (0.3, 0.4 mm, $p > 0.05$) and recession reduction (0.2, 0.3 mm, $p > 0.05$) (Castro, et al. 2017).

(iv) Growth factors

Recombinant Human Platelet-Derived Growth Factor-BB (rhPDGF-BB) has been evaluated clinically and histologically for the treatment of gingival recession defects. Clinical results showed 90.8% root coverage with rhPDGF, compared with 98.6% root coverage with SCTG (McGuire, et al. 2009a). Histologic evidence demonstrated de novo alveolar bone, cellular cementum, and PDL regeneration mediated by rhPDGF-BB (McGuire, et al. 2009b).

(v) Living cell construct

Living cellular construct (LCC) is a combination of allogenic human keratinocytes, fibroblasts, human extracellular matrix proteins and bovine collagen. This material has been used as a substitute for FGG for the treatment of gingival recession defects, where root coverage is not required. In a randomized controlled trial, comparing LCC to FGG (McGuire, et al 2011). Results have shown more keratinized gingiva generated by FGG (mean 4.5mm) than LCC (mean 3.2mm). LCC regenerated keratinized gingiva of 2mm or more in 95.3% of the patients.

Attachment 2: Western Society of Periodontology 2016: Research Award

Research Project: "Three-dimensional Volumetric Analysis of Gingival Augmentation for the treatment of multiple recession defects by Vestibular Incision Subperiosteal Tunnel Access (VISTA)"

Director: Professor Niklaus Lang

Location: Las Vegas

Date: June 2016

Certificate of Recognition

FIRST PLACE AWARD

This certificate is awarded to

Dr. Alfonso Gil Lopez-Areal

For Outstanding Research and Presentation at the 62nd Annual Scientific Session of the Western Society of Periodontology

On this 25th day of June, 2016

Tom Kepic, D.D.S., M.S.
President

Homa H. Zadeh, D.D.S., Ph.D.
Program Chair & President-Elect

THE WESTERN SOCIETY OF PERIODONTOLOGY

Attachment 3: Spanish Society of Periodontology 2018: Award to the best Oral Research Communication

Research Project: "Three-dimensional digital analysis of multiple recession-type defects treated by VISTA: a pilot study"

Director: Dr Homayoun Zadeh

Location: SEPA Sevilla

Date: June 2018

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FUNDACIÓN SEPA DE PERIODONCIA E IMPLANTES DENTALES

Dr. José Nart Molina, Secretario de la Fundación SEPA de Periodoncia e Implantes Dentales

CERTIFICA QUE:

Dr. Alfonso Gil ha resultado ganador en la **Comunicación en Formato Video** "Three-dimensional digital analysis of multiple recession-type defects treated by vestibular incision subperiosteal tunnel access (vista): a pilot study" firmada por Alfonso Gil, José Nart y Hamayoun Zadeh en la **Reunión Anual SEPA Sevilla,** celebrada en Sevilla, los días 12, 13 y 14 de abril 2018.

Y para que así conste a los efectos oportunos, firma el presente Certificado en Sevilla el 14 de abril de 2018.

Dr. José Nart Molina
Secretario

Attachment 4: Spanish Society of Periodontology 2019:

Lecture in Session: Periodoncia y Prótesis

Research Project: “Cubrimiento radicular previo al tratamiento restaurador: VISTA”

Director: Dr Adrián Guerrero

Location: SEPA Valencia

Date: May 2019

Sepa '19

El congreso
de la periodoncia
y la salud bucal

Feria Valencia
29 mayo - 1 junio
2019

SEPA PERIODONCIA
SEPA INTERDISCIPLINAR
SEPA HIGIENE
SEPA GESTIÓN
EXPOPERIO

CERTIFICADO DE PONENTE

La Sociedad Española de Periodoncia y Osteointegración certifica que

Alfonso Gil

Ha realizado la sesión

Cubrimiento radicular previo al tratamiento restaurador

en el congreso SEPA 2019 celebrado en
Valencia del 29 mayo al 1 de junio de 2019

Dr. Antonio Bujaldón
Presidente SEPA

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